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# ENVIRONMENTAL RESEARCH BRIEF

## Pollution Prevention Assessment for a Manufacturer of Paints and Coatings

Marvin Fleischman*, Patrick A. Schmidt*,
and Gwen P. Looby**

### Abstract

The U.S. Environmental Protection Agency (EPA) has funded a pilot project to assist small and medium-size manufacturers who want to minimize their generation of waste but who lack the expertise to do so. Waste Minimization Assessment Centers (WMACs) were established at selected universities and procedures were adapted from the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). That document has been superseded by the *Facility Pollution Prevention Guide* (EPA/600/R-92/088, May 1992). The WMAC team at the University of Louisville performed an assessment at a plant that manufactures paints and coatings. Raw materials are received and staged appropriately for batches of product. Processing in this plant includes mixing of raw materials, filtering, pumping and milling. Additional materials may be added in letdown tanks prior to product filling, packaging, and shipping. The team's findings and recommendations indicated that the plant generated waste wash water and solvent from equipment cleaning in large quantities and that significant waste reduction and cost savings could be achieved by removing more of the product from the letdown tanks prior to cleaning them.

This Research Brief was developed by the principal investigators and EPA's National Risk Management Research Laboratory, Cincinnati, OH, to announce key findings of an ongoing research project that is fully documented in a separate report of the same title available from University City Science Center.

### Introduction

The amount of waste generated by industrial plants has become an increasingly costly problem for manufacturers and an additional stress on the environment. One solution to the problem of waste generation is to reduce or eliminate the waste at its source.

University City Science Center (Philadelphia, PA) has begun a pilot project to assist small and medium-size manufacturers who want to minimize their generation of waste but who lack the in-house expertise to do so. Under agreement with EPA's National Risk Management Research Laboratory, the Science Center has established three WMACs. This assessment was done by engineering faculty and students at the University of Louisville's WMAC. The assessment teams have considerable direct experience with process operations in manufacturing plants and the knowledge and skills needed to minimize waste generation.

The pollution prevention opportunity assessments are done for small and medium-size manufacturers at no out-of-pocket cost to the client. To qualify for the assessment, each client must fall within Standard Industrial Classification Code 20-39, have gross annual sales not exceeding $75 million, employ no more than 500 persons, and lack in-house expertise in pollution prevention.

The potential benefits of the pilot project include minimization of the amount of waste generated by manufacturers and reduction of waste treatment and disposal costs for participating plants. In addition, the project provides valuable experience for graduate and undergraduate students who participate in the program, and a cleaner environment without more regulations and higher costs for manufacturers.

### Methodology of Assessments

The pollution prevention opportunity assessments require several site visits to each client served. In general, the WMACs

*University of Louisville, Department of Chemical Engineering.
**University City Science Center, Philadelphia, PA.

follow the procedures outlined in the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). The WMAC staff locate the sources of waste in the plant and identify the current disposal or treatment methods and their associated costs. They then identify and analyze a variety of ways to reduce or eliminate the waste. Specific measures to achieve that goal are recommended and the essential supporting technological and economic information is developed. Finally, a confidential report that details the WMAC's findings and recommendations (including cost savings, implementation costs, and payback times) is prepared for each client.

## Plant Background

The plant manufactures oil- and water-based interior and exterior architectural coatings, coatings for metal surfaces, and other specialty coatings. It operates 4,125 hr/yr to produce over 6 million gal/yr of product.

### *Manufacturing Process*

Bulk liquids, including solvents, liquid resins, glycols, and powders, including pigment, are received and stored. As customer orders are received and scheduled for production, the required raw materials are collected according to a specific batch recipe and staged.

Appropriate raw materials are mixed in the tank. The proper particle size distribution in the final product is achieved using either specially equipped dispersion tanks or mixing tanks in conjunction with a milling process afterward. Once the proper particle size is obtained in the batch, it is fed to a letdown tank directly or indirectly through a filter, a pump, a mill, or any combination of these pieces of equipment.

Once a batch from a dispersion tank is transferred to a letdown tank, additional solvent and rheological additives are added in order to adjust the batch's viscosity. Additives for other desirable product properties are also added in the letdown tank. After the batch is approved by the quality control department, it is sent to a filling machine.

Large batches are packaged automatically and small batches are packaged semi-automatically or manually.

Lower quality paint is manufactured using waste products such as quality control samples and customer returns. This paint is used when color matches are not critical or when the presence of metal-containing compounds does not pose a significant hazard.

An abbreviated process flow diagram for this plant is shown in Figure 1.

### *Existing Waste Management Practices*

This plant already has taken the following steps to manage and minimize its wastes:

- Most metal drums are returned to the supplier, sent to be reconditioned, or used for hazardous waste disposal.
- Pallets from raw material shipments are reused, returned to the supplier, or given away.
- Bulk liquid storage tanks are equipped with conservation vents.
- Process equipment is dedicated to either oil-based or water-based production in order to minimize cleaning waste.
- Long runs and light-to-dark runs are scheduled sequentially to minimize cleaning waste.
- Mercury-containing paint has been phased out of production.
- Caustic and alkaline cleaners are not used by the facility.
- Pigment dust from three of the baghouses is returned to the appropriate batch.
- Buckets are reused as long as possible in the prebatching area.
- Equipment is cleaned immediately after a batch is finished in order to reduce the amount of water or solvent required. Some of the wash solvent and water is incorporated into the batch being made.
- Foam plugs or "pigs" are used for cleaning some of the lines and recovering product.
- Cardboard layers separating the cans used for the product packaging are used as spill absorbents, reducing the quantity of absorbents purchased. A portion of the separators is returned to the supplier for reuse.
- Oil-based and water-based wastes are segregated.
- Reusable wire strainers are used for filtration instead of cartridge filters.
- Several potential waste streams are reused in formulating lower-quality paint.
- Damaged dry metal product cans are recycled offsite.
- Waste cardboard and office paper are recycled offsite.
- Styrofoam "popcorn" received with shipments is reused in outgoing shipments.

## Pollution Prevention Opportunities

The type of waste currently generated by the plant, the source of the waste, the waste management method, the quantity of the waste, and the annual waste management cost for each waste stream identified are given in Table 1.

Table 2 shows the opportunities for pollution prevention that the WMAC team recommended for the plant. The opportunity, the type of waste, the possible waste reduction and associated savings, and the implementation cost along with the payback time are given in the table. The quantities of waste currently generated by the plant and possible waste reduction depend on the production level of the plant. All values should be considered in that context.

It should be noted that the economic savings of the opportunity, in most cases, result from reductions in raw materials and waste treatment and disposal costs. Other savings not quantifiable by this study include a wide variety of possible future costs related to changing emissions standards, liability, and employee health. It also should be noted that the savings given are for each pollution prevention opportunity independently and

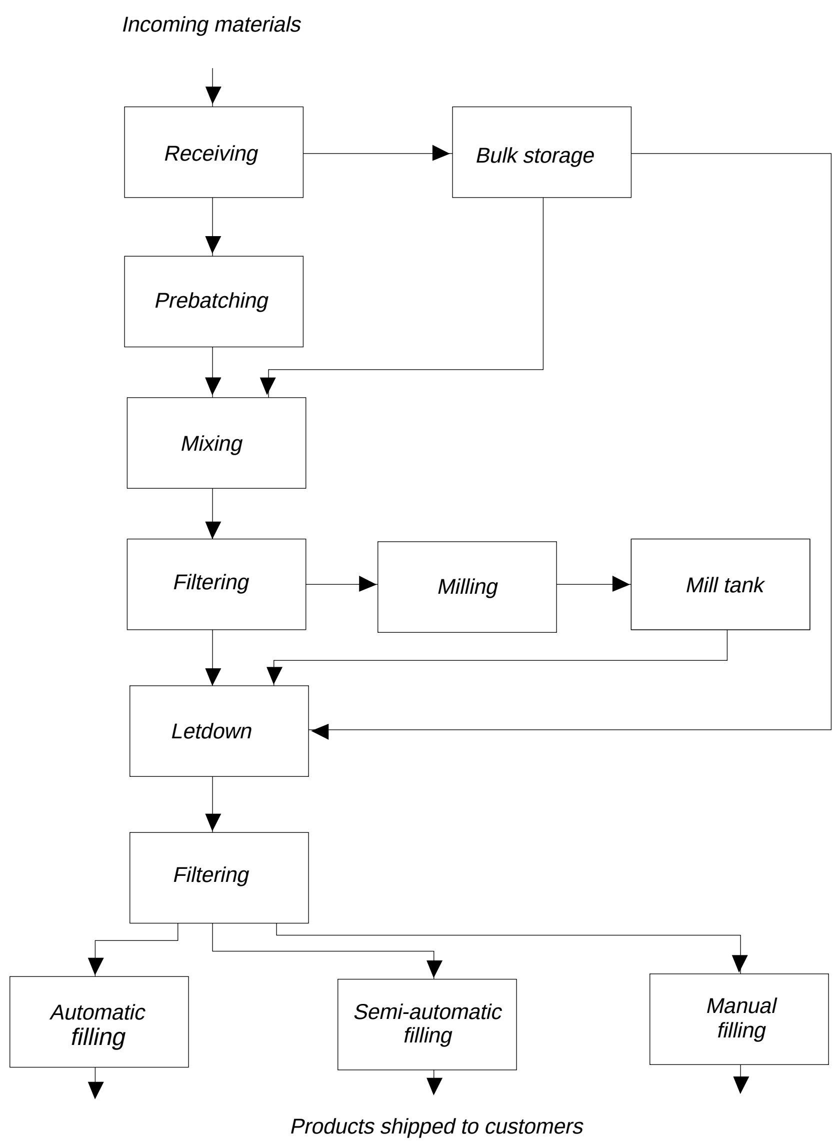


***Figure 1.*** *Abbreviated process flow diagram for paint formulation.*

***Table 1.*** *Summary of Current Waste Generation*

| *Waste Generated* | *Source of Waste* | *Waste Management Method* | *Annual Quantity Generated (lb/yr)* | *Annual Waste Management Cost*[1] |
|---|---|---|---|---|
| *Pigment bags and residual powder* | *Raw materials handling* | *Compacted; shipped offsite to landfill* | *507,000* | *$225,000* |
| *Fiber drums, paper bags, and buckets* | *Raw materials handling* | *Shipped offsite to landfill* | *5,100* | *3,810* |
| *Metal drums* | *Raw material handling* | *Shipped offsite for reconditioning* | *683,000* | *125,000* |
| *Solvent drum heels (lost with drums shipped offsite)* | *Raw material handling* | *Shipped offsite* | *272,000* | *42,600* |
| *Dispersed pigment dust* | *Raw material handling* | *Collected in baghouses; shipped offsite to landfill* | *750* | *770* |
| *Evaporated solvent* | *Raw material handling* | *Evaporated to plant air and atmosphere* | *2,000* | *300* |
| *Packaging/shipping wastes (shrink wrap and binding straps)* | *Received with raw materials* | *Shipped offsite to landfill* | *55,000* | *1,160* |
| *Pallets* | *Received with raw materials* | *Reused onsite, returned to supplier, or given away* | *1,400,000* | *-* |
| *Cardboard* | *Received with raw materials* | *Shipped offsite for recycling* | *n/a* | *n/a* |
| *Raw material samples* | *Quality control sampling* | *Blended into maintenance paint* | *14,400* | *-* |
| *Raw material sample cans* | *Quality control sampling* | *Shipped offsite to landfill* | *1,600* | *30* |
| *Drip bucket liquid* | *Leaks from product formulation* | *Blended into maintenance paint* | *2,500* | *-* |
| *Drip buckets* | *Used to contain leaks* | *Shipped offsite to landfill* | *100* | *negligible* |
| *Wash water/paint solids* | *Equipment cleaning for water-based paint* | *Sewered* | *11,300,000* | *358,320* |
| *Supernatant from metal-containing wash water* | *Equipment cleaning for metal-containing water-based paint* | *Decanted from sludge; sewered* | *280,000* | *8,680* |
| *Sludge from metal-containing wash water* | *Equipment cleaning for metal-containing water-based paint* | *Blended into fence paint* | *271,800* | *-* |
| *Spent wash solvent/paint solids* | *Equipment cleaning for oil-based paints* | *Shipped offsite to be used as fuel* | *967,000* | *2,877,000* |
| *Solvent-based filter/strainer solids* | *Filtering during solvent-based paint production* | *Shipped offsite as hazardous waste; landfilled or burned* | *12,000* | *20,300* |
| *Water-based filter/strainer solids* | *Filtering during water-based paint production* | *Shipped offsite to landfill* | *37,200* | *780* |
| *Clean-up waste (rags, floor sweepings, pigment dust)* | *Clean-up* | *Shipped offsite to landfill* | *16,300* | *340* |
| *Damaged metal containers* | *Product handling* | *Shipped offsite to landfill or for recycling* | *513,000* | *353,820* |
| *Damaged plastic containers* | *Product handling* | *Shipped offsite to landfill* | *184,000* | *143,880* |
| *Damaged cardboard boxes* | *Product packaging* | *Shipped offsite for recycling* | *77,000* | *-* |
| *Damaged packaging material* | *Product packaging* | *Shipped offsite to landfill* | *40,400* | *850* |
| *Miscellaneous wastewater* | *Various sources* | *Sewered* | *20,800,000* | *5,140* |

[1]*Includes waste treatment, disposal, and handling costs, and applicable lost raw material value.*

do not reflect duplication of savings that would result when the opportunities are implemented in a package.

## Additional Recommendations

In addition to the opportunities analyzed by the WMAC team, several additional measures were considered. These measures were not completely analyzed because of insufficient data, minimal savings, implementation difficulty, or a projected lengthy payback. Since one or more of these approaches to pollution prevention may, however, increase in attractiveness with changing conditions in the plant, they were brought to the plant's attention for future consideration.

The measures considered include the following:

- Obtain raw materials in dissolvable bags to reduce packaging wastes.
- Use pastes or slurries instead of powdered pigment to reduce the quantity of waste paper bags generated.
- Purchase raw materials in reusable containers.
- Reuse "empty" powder bags in prebatching instead of shipping them to landfill.
- Find an appropriate method of recycling empty paper bags.
- Reduce pigment dust losses by installing deflector curtains on the tank lids attached to the mixers.
- Use currently discarded pigment dust in fence paint when possible.
- Recover solvent losses by using chillers, adsorbers, or compressors on the bulk storage tank vents.
- Install and use lids on process tanks to prevent evaporative losses.
- Replace splash filling of tanks with submerged filling.
- Install high-pressure low-volume nozzles to reduce the amount of cleaning water used.
- Use hydrocyclone to remove suspended solids from wash water thereby reducing water quality surcharges.
- Use countercurrent solvent rinsing of tanks for cleaning.
- Investigate the possibility of sending damaged labels back to the supplier for recycling.

This research brief summarizes a part of the work done under Cooperative Agreement No. CR-814093 by the University City Science Center under the sponsorship of the U.S. Environmental Protection Agency. The EPA Project Officer was **Emma Lou George**.

***Table 2.*** *Summary of Recommended Pollution Prevention Opportunities*

| Pollution Prevention Opportunity | Waste Reduced | Annual Waste Reduction: Quantity (lb/yr) | Annual Waste Reduction: Percent | Net Annual Savings | Implementation Cost | Simple Payback (yr) |
|---|---|---|---|---|---|---|
| Recover additional pigment raw material from paper bags by increased shaking of the bags over the tanks. Currently, a considerable amount of unused pigment is sent to the landfill along with the "empty" paper bags. | Pigment bags and residual powder | 205,000 | 40 | $190,000 | 0 | immediate |
| Coat the letdown tanks with a lining that will cause the product to bead and drain more effectively, thereby reducing the amount of product wasted and the quantity of water or solvent used during equipment cleaning. | Wash water/paint solids<br>Spent wash solvent/ paint solids | 2,532,000<br>218,000 | 22<br>22 | 169,320 | 281,600[1] | 1.7 |
| Use rubber squeegees to remove product from the sides of the letdown tanks before using liquid cleaning agents. | Wash water/paint solids<br>Spent wash solvent/ paint solids | 2,532,000<br>218,000 | 22<br>22 | 154,920 | 120 | immediate |
| Install drain valves at the lowest points of nondraining pipes between the letdown tanks and the filling tanks, thereby reducing the amount of product wasted and the quantity of water or solvent used during equipment cleaning. | Wash water/paint solids<br>Spent wash solvent/ paint solids | 900,140<br>32,020 | 8<br>3 | 26,970 | 2,000 | 0.1 |
| Store spent wash solvent/paint waste in containers and reuse in the formulation of future product batches. | Spent wash solvent/ paint solids | 871,000 | 90 | 358,310 | 3,700 | immediate |
| Request that suppliers of raw materials use specially designed drums that drain more completely in order to reduce the plant's drum heel losses. | Solvent drum heels | 269,610 | 99 | 42,240 | 0 | immediate |
| Allow spent wash solvent/paint waste to settle for one day. Decant supernatant and reuse in cleaning operations. | Spent wash solvent/ paint solids | 193,000 | 20 | 28,500 | 0 | immediate |
| Install an onsite solvent recovery unit to recover spent wash solvent for reuse. | Spent wash solvent/ paint solids | 537,000 | 55 | 80,460 | 56,000 | 0.7 |
| Install an ultrafiltration system to recover some of the spent wash solvent for reuse. | Spent wash solvent/ paint solids | 415,000 | 43 | 79,500 | 27,000 | 0.4 |
| Send waste paint, powder dust, and solvent-based filter cake that is not contaminated with dirt to a paint recovery plant to be reprocessed instead of shipping it to a hazardous waste facility for landfilling or burning. | Solvent-based filter/ strainer solids | 6,600 | 55 | 6,000 | 0 | immediate |
| Reduce losses of pigment used as a raw material. Install bulk storage silos for the pigments used in largest quantities. Use a pneumatic conveying system to deliver the pigments to the mixing or letdown tanks. | Pigment bags and residual powder | 101,000 | 20 | 47,900 | 115,000 | 2.4 |

*[1] It is possible that a less expensive coating method can be used. This implementation cost estimate is based upon vendor information for an epoxy resin coating. Testing should be done in order to identify a suitable coating material.*

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Cincinnati, OH 45268

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